

m. of the 8th, as high area III was to the north of Montana, but this was the only fall of consequence. As high No. VII approached Montana a fall of  $44^{\circ}$  in twenty-four hours occurred at Rapid City, p. m. of 21st. On a. m. of 22d the cold wave had extended southward, causing a fall of  $42^{\circ}$  at Wichita. Evening of the same day a fall of  $46^{\circ}$  was experienced at Concordia and Dodge City. This cold wave was broken up as it approached the Atlantic Coast, p. m. of 24th, by the rather permanent high area over the South Atlantic States.

As high No. IX moved into Dakota it caused a fall in temperature of  $34^{\circ}$  at Cheyenne, p. m. of 26. The cold wave extended south to the west Gulf States, p. m. of 27th, a fall of  $38^{\circ}$  occurring at Oklahoma. The cold wave diminished rapidly in intensity as it approached the Alleghanies and was practically over by the 29th.

#### LOWS.

As will be seen from Chart II three lows began to the north and northwest of Montana, four in southern Plateau on the border of the United States, two in the east Gulf States, and one in the upper Lake Region. The general movement was eastward or northeastward, and eight disappeared off the north Atlantic Coast. Nos. II and IX were last noted in the upper Lake Region. The storms of the north were quite moderate for March. A wind of 52 miles an hour occurred at Savannah, p. m. of 3d, as low No. II reached Florida. As this storm moved up the coast it caused a wind of 56 miles at Cape Henry, a. m. of 5th. As low No. V reached the lower Lake Region it caused a wind of 52 miles at Cleveland, a. m. of 13th, and 60 miles at Buffalo, p. m. of same day. Buffalo also reports a wind of 56 miles, p. m. of 19th, as low No. VII moved down the St. Lawrence. A wind of 56 miles was ex-

perienced at Toledo, p. m. of 27th, as low No. IX approached the upper Lake Region, and Chicago reported 64 miles the morning of the 27th.

#### Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
<b>High areas.</b>										
I.....	28, a. m.†	53	111	4, p. m.	47	59	3,020	4.5	671	28.0
II.....	2, a. m.	51	112	8, a. m.	41	70	2,710	6.0	452	18.8
III.....	7, p. m.	49	127	11, a. m.	49	84	2,450	3.5	700	29.2
IV.....	8, a. m.	47	127	16, p. m.	39	70	4,690	8.5	552	23.0
V.....	15, a. m.	51	116	19, p. m.	46	59	3,280	4.5	729	30.4
VI.....	17, a. m.	51	109	18, p. m.	51	101	390	1.5	.....	.....
VII.....	19, a. m.	41	113	22, p. m.	43	64	2,490	3.5	711	29.6
VIII.....	20, a. m.	55	114	26, p. m.	48	58	4,650	6.5	715	29.8
IX.....	24, a. m.	54	111	1, a. m.†	40	78	2,550	8.0	319	13.3
Total.....							25,840	45.0	4,849	
Mean of 8 tracks.....							3,230	.....	606	25.3
Mean of 45 days.....									574	23.9
<b>Low areas.</b>										
I.....	28, a. m.†	50	90	3, a. m.	41	69	2,070	3.0	690	28.8
II.....	2, p. m.	29	88	5, p. m.	47	58	2,100	3.0	700	29.2
III.....	6, a. m.	53	114	10, a. m.	51	86	1,950	4.0	487	20.3
IV.....	9, p. m.	38	111	12, p. m.	49	69	2,490	3.0	890	34.6
V.....	10, p. m.	32	114	13, p. m.	50	67	3,150	3.0	1,050	43.7
VI.....	12, a. m.	51	124	18, a. m.	48	62	3,790	6.0	632	26.3
VII.....	16, p. m.	39	113	21, a. m.	47	55	3,090	4.5	687	28.6
VIII.....	20, a. m.	32	102	24, a. m.	48	51	3,090	4.0	772	32.2
IX.....	22, p. m.	54	112	28, a. m.	50	85	3,060	5.5	556	22.2
X.....	29, p. m.	32	84	1, a. m.†	44	61	1,470	2.5	588	24.5
Total.....							26,260	38.5	6,992	
Mean of 10 tracks.....							2,626	.....	699	29.1
Mean of 35.5 days.....									683	28.4

• Not used in means.

† February.

‡ April.

## THE WEATHER OF THE MONTH.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

The statistical aspect of the weather of the month is presented in the tables which form the closing part of this REVIEW. Table I in particular contains a variety of details from which the reader may select those most interesting to himself. The numerical values in the tables have been generalized in a number of cases, the results appearing on Charts Nos. III to IX, inclusive.

#### PRESSURE AND WIND.

*Normal conditions.*—The geographic distribution of normal barometric readings at sea level and under local gravity for March is shown by Chart VI of the MONTHLY WEATHER REVIEW for March, 1893.

There is generally a decrease in pressure over the United States and Canada in March, the decrease being greatest (0.10 inch) in New England, the Canadian Maritime Provinces, and Saskatchewan. Mean values over the northern and central Plateau regions also show reductions of from 0.05 to 0.10 inch. The regions of maximum pressure are in northern Minnesota and southern Georgia, with values of 30.15 and 30.10, respectively. The configuration of the isobars in March suggests a breaking up of the conditions that prevail during the winter season. The dominant high of the central Plateau region has almost disappeared; warm southerly winds from Arizona and the Gulf of California have set in toward interior plateaus and the establishment of a summer low in the place of the winter high has begun.

The prevailing winds in March are not materially different, as regards direction, from those of February, heretofore described (Vol. XXVI, p. 49). The principal changes occur on

the south Atlantic Coast, where the northwesterly winds of February are supplanted by southwesterly winds in March, and in the southwestern districts, where southerly and southwesterly winds prevail, instead of the northerly winds of winter.

*The current month.*—Pressure was above normal from the Mississippi eastward to the Atlantic Coast, and also on the northern Slope and the north Pacific Coast. It was below normal over California, the Southwest, the Rocky Mountain Region south of Idaho, and the plains from the Gulf of Mexico to the British Possessions. Pressure was unusually high for the season over New England and the Canadian Maritime Provinces, the excess at Eastport and Halifax being 0.30 inch.

The highs of the month, in almost all cases, followed the northern track and persisted for several days over New England. The lows, in the majority of cases, moved from the Southwest to the Lake Region, thence easterly north of New England. As a result the prevailing winds of the latter were southerly or southeasterly, giving fair weather and abnormally high temperature to all of New England.

The movement of areas of low pressure from the Southwest to the St. Lawrence Valley, via the Lake Region, necessarily accompanies warm southerly winds over the Mississippi and Ohio valleys. The dividing line between southerly and southeasterly winds on the one hand, and northwesterly on the other, extends northeasterly from Denver to Duluth, a position considerably farther to the northwest than is usual. The winds of the Pacific Coast were almost invariably from the northwest, while those of the Mountain and Plateau regions were generally southwesterly.

## TEMPERATURE OF THE AIR.

*Normal conditions.*—The normal mean temperature of the air in the United States in March varies from about 73° at Key West, 62° at Jacksonville, 62° at New Orleans, 62° at Galveston, 56° at San Diego to 29° at Eastport, 28° at Burlington, 30° at Buffalo, 32° at Detroit, 24° at Duluth, 15° at St. Vincent, 29° at Havre, 40° at Spokane, and 45° at Seattle, on Puget Sound. The warmest regions, as may be seen from the above figures, are the South Atlantic, Gulf, and Pacific Coast States; the coldest are the Red River Valley of the North and contiguous territory. The Pacific Coast is somewhat warmer than the Atlantic, and both are considerably warmer than the interior.

The differences between the normal temperatures of February and March are not large at stations on the South Atlantic, Gulf, and Pacific coasts, but at inland points, especially on the plains and in the upper Missouri Valley, the increase in the mean values of March over those of February is quite marked. The advent of spring in the last named region comes, therefore, a little earlier than in the Ohio Valley and elsewhere east of the Mississippi.

In studying the distribution of monthly mean temperatures it will be found very helpful to consult the charts at the end of this REVIEW, especially No. VI, Surface Temperatures, Maximum, Minimum, and Mean. This chart gives a very good idea of the variations of temperature with latitude and longitude, and also of the distribution of normal surface temperatures. Chart VI for any month will differ from a normal chart merely in the displacement or bending of the isotherms northward or southward according as the temperature of the particular locality is above or below the normal for the place and season.

*The current month.*—With the exception of three short periods of cold weather the month as a whole was unseasonably warm over nearly all the region east of the Rocky Mountains. West of the mountains, including also a narrow strip along the eastern foothills, the month was colder than usual.

The cold periods were: 1st to 3d, 20th to 24th, and 25th to 29th. The first of these was not especially severe, yet it brought the lowest temperatures of the month to the majority of stations in the South, and also in the Ohio Valley, the Middle States, and New England. The second cold wave entered Montana from the northward on the 20th, moved southeasterly along the main chain of the Rocky Mountains on the 22d, reaching the Gulf Coast on the morning of the 24th, whence it spread slowly northeastward, dissipating, however, before it reached the Atlantic Coast.

The lowest temperature observed during the passage of this cold wave and, in fact, the lowest observed within the limits of the United States during the month, was 37° below zero in Montana on the 22d. The temperature gradients in front of the cold wave, especially throughout Nebraska, Kansas, Missouri, and Arkansas, were very sharp, and falls of 60° in twelve hours were not uncommon.

In Arkansas the temperature dropped from 79° on the 22d to 29° on the morning of the 23d. The temperature west of the Continental Divide likewise fell sharply on the 22d and 23d. The third and last cold wave of the month, like the second, originated north of Montana. The lowest temperature reported in its course southeastward was 18° below zero at Havre, Mont., on the 26th.

Maximum temperatures of 90° and over were registered in Florida, Texas, Arizona, and the desert region of California. The highest maximum of the month was 101°, at Fort McIntosh, Tex., and the lowest minimum, 37° below zero, at Adel, Mont., an absolute range of 138°.

The distribution of the observed monthly mean temperature of the air is shown by red lines (isotherms) on Chart VI. This chart also shows the maximum and the minimum tem-

peratures, the former by broken and the latter by dotted lines. As will be noticed, these lines have been drawn over the Rocky Mountain Plateau Region, although the temperatures have not been reduced to sea level; the isotherms relate, therefore, to the average surface of the country in the neighborhood of the various observers, and as such must differ greatly from the sea-level isotherms of Chart IV.

The average temperatures of the respective geographic districts, the departures from the normal of the current month and from the general mean since the first of the year, are presented in the table below for convenience of reference:

*Average temperatures and departures from the normal.*

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England.....	10	39.5	+ 6.6	+10.3	+ 3.4
Middle Atlantic.....	12	46.8	+ 7.4	+10.5	+ 3.5
South Atlantic.....	10	59.1	+ 5.4	+ 6.3	+ 2.1
Florida Peninsula.....	7	69.0	+ 3.6	+ 1.5	+ 0.5
East Gulf.....	7	62.4	+ 3.9	+ 5.8	+ 1.9
West Gulf.....	7	59.6	+ 1.8	+10.4	+ 3.5
Ohio Valley and Tennessee....	12	51.1	+ 7.1	+11.3	+ 3.8
Lower Lake.....	8	42.4	+10.0	+15.3	+ 5.1
Upper Lake.....	9	34.8	+ 7.7	+16.3	+ 5.4
North Dakota.....	7	22.4	+ 1.5	+24.1	+ 8.0
Upper Mississippi.....	11	41.2	+ 5.4	+15.7	+ 5.2
Missouri Valley.....	10	39.0	+ 3.2	+18.8	+ 6.3
Northern Slope.....	7	26.6	+ 5.2	+ 9.0	+ 3.0
Middle Slope.....	6	41.9	+ 0.4	+ 9.4	+ 3.1
Southern Slope.....	5	51.2	+ 0.6	+10.8	+ 3.6
Southern Plateau.....	13	45.7	+ 2.7	+ 2.1	+ 0.7
Middle Plateau.....	9	34.1	+ 4.3	+ 8.3	+ 2.8
Northern Plateau.....	11	34.9	+ 2.9	+ 3.9	+ 1.3
North Pacific.....	9	42.9	+ 2.1	+ 3.0	+ 1.0
Middle Pacific.....	5	49.9	+ 2.4	+ 3.4	+ 1.1
South Pacific.....	4	53.9	+ 1.6	+ 1.9	+ 0.6

*In Canada.*—Professor Stupart says:

The mean temperature of March was below average in the Northwest Territories, and particularly so in the southern portions of Alberta and Assiniboia, where the departure was from 8° to 10°. In western Manitoba the normal was just maintained, but thence eastward across the Lake Region there was an increasing plus departure, and in the Parry Sound, Nipissing, and upper Ottawa districts the mean was as much as 13° above average, and in southern Ontario from 6° to 9° above. From the Ottawa Valley east the departure became gradually less marked, and in the Maritime Provinces it was very generally between 6° and 8°.

*Review of the season.*—The chief characteristic of the winter that has just closed was its unusual mildness in the Lake Region, the Missouri Valley, the Dakotas, and elsewhere east of the Rocky Mountains.

The ice on the Great Lakes was not heavy and navigation on lower Lake Michigan was at no time interrupted. The Straits of Mackinac were clear by the 28th, the earliest date but one in sixty-three years.

On the Pacific Coast, December, January, and March were cold and dry; February was warmer than the average, but the winter, as a whole was colder than usual.

## PRECIPITATION.

*Normal conditions.*—The regions of heavy precipitation in March (4 to 6 inches) agree substantially with those of February, so far as their positions are concerned. In extent, however, they are smaller and there is a marked diminution in the amount of rain that falls, especially on the Pacific Coast. The regions of moderate precipitation (2 to 4 inches) embrace the greater portion of the California coast, the lower Lake Region, the Ohio Valley, the Middle States, and New England, with smaller areas in Florida, the south Atlantic Coast, the west Gulf States, and the middle Mississippi Valley. The regions of scant precipitation are substantially the same as in the preceding month.

*The current month.*—The geographic distribution of precipitation for the current month is shown on Chart III.

Heavy rains fell over an oblong shaped area extending northeasterly from Arkansas to the lower Lakes, the fall being particularly heavy (10 inches and over) in Arkansas and Missouri. Relatively heavy precipitation, 215 per cent of the normal, occurred throughout the upper Mississippi Valley, and the fall over the northern slope was also generally in excess of the normal.

In Florida and along the Gulf Coast to eastern Texas the fall was much below the normal, the deficit being greatest in central Florida, where it is reported streams and wells are failing by reason of the drought.

The rainfall of the Pacific Coast was also greatly below the normal, much to the detriment of agricultural interests in that region. The partial failure of winter rains in California is not fraught with great danger to growing crops, provided seasonable rains fall throughout March and April. While the rainfall of December, 1897, and January, 1898, was much below normal, February gave moderate rains in almost all sections. The rains of March, however, fell greatly below the average, especially along the coast, and the outlook at the end of the month was not assuring.

The table below shows the total rainfall at the stations named from September 1 to March 31 of each year during which observations were made. The figures are of special interest at the present time.

Total or accumulated precipitation at selected California stations from September 1 to March 31.

Season.	Coast.					Great Valley.					Los Angeles.
	Fort Ross.	San Francisco.	Santa Cruz.	San Luis Obispo.	Santa Barbara.	Yreka.	Red Bluff.	Sacramento.	Tulare.	Grass Valley.*	
	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.	Inch.
1849-50.	32.6	5.3						31.4	2.9		
1850-51.	17.1							17.5			
1851-52.	30.5							31.4			
1852-53.	20.1							17.9			
1853-54.	17.1							13.2			
1854-55.	18.2							9.8			
1855-56.	19.6							10.1			
1856-57.	19.9							17.5			
1857-58.	20.1							14.0			
1858-59.	16.1							16.6			
1859-60.	17.3							14.4			
1860-61.	47.7							32.9			
1861-62.	11.9							9.6			
1862-63.	7.7							5.9			
1863-64.	22.6							20.7			
1864-65.	21.1							15.1			
1865-66.	32.6							29.4			
1866-67.	36.3							30.2			
1867-68.	19.1							14.7			
1868-69.	14.1							11.1			
1869-70.	10.2							6.3			
1870-71.	29.8							22.6			
1871-72.	15.2							13.7			
1872-73.	23.0							21.6			
1873-74.	48.2	15.7						5.9			
1874-75.	54.6	20.7						6.7			
1875-76.	29.6	10.6						1.6			
1876-77.	39.4	34.0						6.5			
1877-78.	45.7	20.3						4.8			
1878-79.	60.5	26.8						9.2			
1879-80.	39.3	14.5						2.8			
1880-81.	35.8	15.1						4.0			
1881-82.	31.6	23.1						8.3			
1882-83.	33.9	14.7						7.4			
1883-84.	33.9	27.3						3.7			
1884-85.	23.0	16.3						5.1			
1885-86.	25.1	15.9						6.2			
1886-87.	24.5	20.7						28.3			
1887-88.	43.5	53.0						11.5			
1888-89.	18.9	15.7						18.2			
1889-90.	15.1	18.6						6.6			
1890-91.	20.6	32.8						6.1			
1891-92.	55.0	16.1						4.4			
1892-93.	69.3	23.5						4.3			
1893-94.	45.9	15.3						4.5			
1894-95.	59.9	22.3						8.8			
1895-96.	30.1	7.4						23.4			
1896-97.								13.6			
1897-98.											

\*Foothills region.

†Upper Sierras.

Averages and departures by districts are summarized for convenience of reference in the following table:

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		Inches.	Inches.
New England.	10	2.64	67	-1.30	+0.80
Middle Atlantic.	12	2.79	72	-1.10	-3.10
South Atlantic.	10	2.92	65	-1.60	-6.80
Florida Peninsula.	7	1.45	49	-1.50	-5.00
East Gulf.	7	2.66	45	-3.20	-6.00
West Gulf.	7	3.71	109	+0.30	-0.40
Ohio Valley and Tennessee.	12	6.31	146	+2.00	+2.20
Lower Lake.	8	3.20	123	+0.60	+1.70
Upper Lake.	9	2.97	143	+0.90	+1.70
North Dakota.	7	1.44	153	+0.50	-0.20
Upper Mississippi.	11	4.87	215	+2.60	+3.30
Missouri Valley.	10	2.81	155	+1.00	+1.00
Northern Slope.	7	1.32	161	+0.50	-0.10
Middle Slope.	6	0.88	59	-0.60	+0.60
Southern Slope.	6	1.22	100	0.00	0.00
Southern Plateau.	13	0.70	58	-0.50	-1.10
Middle Plateau.	9	1.08	84	-0.20	-2.00
Northern Plateau.	11	0.98	58	-0.70	-1.80
North Pacific.	9	2.38	44	-3.00	-2.90
Middle Pacific.	5	0.51	13	-3.50	-6.90
South Pacific.	4	0.88	40	-1.30	-4.50

In Canada.—Prof. R. F. Stupart says:

The precipitation in the Northwest Territories and Manitoba was almost wholly in the form of snow, which was very generally in excess of the average fall for March. In the older Provinces, on the contrary, the precipitation was chiefly rain, which was in excess of average amount, but owing to the fact that the snowfall was either *nil* or small, the total precipitation for the month was in most localities below normal.

#### SNOWFALL.

The total snowfall for the current month is given in Tables I and II, and its geographic distribution is shown on Chart VIII. The snowfall of the month was rather light in all localities. Less than 20 inches fell in the northern peninsula of Michigan and less than 5 inches over Vermont and New Hampshire. The heaviest fall during the month occurred in Montana directly east of the main chain of the Rocky Mountains.

*Snow on ground at end of month.*—Little snow was reported except in northern New England, on the northern slope and at isolated points in the Plateau Region, and on the mountains of California and Colorado.

The following remarks are taken from the monthly reports of Climate and Crop Service Section Directors of Colorado, Michigan, Montana, and New England:

*Colorado.*—March having been similar to the winter months as regards deficient snowfall, there has been no increase of consequence in the amount of snow stored in the mountains. None of the reports indicate anything near the average March snowfall, though in a few localities the fall has been somewhat greater than during the winter months. The distribution of snowfall in the San Juan Mountains indicates that the early flow of the Rio Grande will be greater than last year, while that of June and July is likely to be less than at any time in the past twenty-five years, unless it is largely supplemented by rains.

*Michigan.*—The average depth of snow on the ground at the beginning of the month in the southern counties was 8.5 inches; in the central counties, nearly 13.0 inches; and in the northern counties, nearly 18.0 inches. This snow in the lower peninsula nearly all disappeared during the first ten days of the month, owing to high temperatures. The melting of the snow was immediately followed by quite general and moderately heavy rains, and during the rest of the month there was more than the normal amount of rainfall.

*Montana.*—The average depth of snowfall was 17.4 inches. The greatest fall was 46 inches at Dearborn Canyon; the least was 3 inches at St. Pauls. In most parts of the State the ground was well covered with snow throughout the month, though correspondents report that in the eastern districts the snow was piled up in low places while the ridges were bare. There seems to be an abundance of snow in the mountains and the prospect is good for plenty of water for irrigating and mining purposes. The snow has been beneficial to grass and winter grain also.

The storm of the 15th was exceptionally heavy in the northeastern part of the State; the snow was drifted to the depth of 6 to 8 feet in places in Lewistown. The cold wave and snowstorm which spread southward down the mountain valleys on the 20th-21st gave heavy snows in this section, which were badly drifted, and being followed on the 24th by another heavy fall with high winds, the cuts were blown full. The Great Northern Road could not get a train through over the Divide for several days, and stage lines were delayed everywhere. Newspaper clippings indicate more snow in the mountains than ever before known at the end of March.

*New England.*—Among the special features of the month worthy of notice, aside from the high average temperature, were the light snow-fall and the gradual disappearance of the immense body of snow on the ground at the beginning of the month without causing floods. In regard to the latter, the Hollingsworth and Whitney Company, Winslow, Me., says: "The manner in which the snow has disappeared has been a surprise to us in this vicinity. The large amount on the ground one month ago caused much fear of a big freshet this spring, but the continued sunshine and lack of rain in quantity have been the means of carrying off practically all the snow so gradually that there has been very little rise in the Kennebec River. Reports from Moosehead Lake show that there is still a very large amount of snow there, which might cause a rise in the river, but as the ice is now running out, and is so porous, there is little danger of a freshet."

The snowfall of the month was decidedly below the average. At many places in the north it did not exceed 5 inches, and the maximum amount reported was 15 inches.

*In Canada.*—Prof. R. F. Stupart says:

In nearly all parts of Manitoba and the Northwest Territories there is a greater depth of snow on the ground than there was at the close of February. This is more particularly the case between Brandon and Qu'Appelle, and northward to Prince Albert and Battleford, where it varies in depth between 2 and 3 feet. There is still snow north of Lake Superior, but it is disappearing. There is also a considerable covering of snow in the lower St. Lawrence Valley and over the larger part of New Brunswick, in which province it varies from about 36 inches in the woods and from 10 to 12 inches in the clearings of the interior to but a few patches in St. John County.

#### ICE IN HARBORS AND OPENING OF NAVIGATION.

*Mackinaw City, Mich., March 28.*—The ice was driven out of the Straits of Mackinac by a heavy southwest gale.

*Menominee, Mich., March 28.*—Ice in Green Bay was driven out by a northwest gale, and the bay is now clear as far as can be seen.

*Cleveland, Ohio, March 29.*—The steamer *Margaret Ohnell* left for Kelleys Island at noon to-day. She is the first vessel to leave port this season.

*Buffalo, N. Y., March 25.*—Steamer *Zenith City* left port for Lorain, Ohio, the first departure of the season.

*Duluth, Minn., March 19.*—Local navigation opened to-day by the arrival of the steamer *McFadden* from Iron River, Wis.

*Sandusky, Ohio, March 25.*—Barge *Keepsake* from Marine City, Mich., the first arrival of the season from upper Lake ports, reached port on the 23d.

*Oneego, N. Y., March 22.*—Navigation opened to-day by the arrival of the schooner *Fred. L. Wells*, light, from Sacket Harbor.

*Yankton, S. Dak., March 8.*—The ice went out of the river at 5 o'clock last evening, and this morning the channel is clear.

*In Canada.*—Prof. R. F. Stupart says:

Throughout the Northwest Territories and Manitoba the river ice is as thick or thicker than at the close of February; 22 inches is reported on the river at Banff, 24 inches at Medicine Hat, 24 inches at Swift Current, 18 inches at Battleford, and 18 inches at Regina. The rivers and Gulf harbors in New Brunswick are still closed; 14 inches is reported on the river at Fredericton, and 10 inches at Chatham.

#### HAIL.

The following are the dates on which hail fell in the respective States:

Arizona, 9, 10, 11, 22, 26. Arkansas, 15, 19, 20. California, 8, 9, 12, 13, 14, 15, 16, 17, 25, 26. Connecticut, 17. Georgia, 15. Illinois, 15, 16, 18, 27. Indiana, 16, 17, 19. Indian Territory, 12, 22, 23, 27. Iowa, 14, 17, 18, 20, 21, 27. Kansas, 14, 17, 22. Kentucky, 15, 16, 17, 19, 23, 30. Louisiana, 2. Minnesota, 14. Mississippi, 3, 12, 14. Missouri, 14, 15, 16, 17, 18, 19, 21, 22, 23, 26. Nebraska, 14, 15, 18. New Mexico, 10. Ohio, 16, 17, 19. Oklahoma, 17, 19, 21, 22, 29. Oregon, 9, 11, 12, 13, 14, 15, 20, 21, 22, 23, 26, 27. Pennsylvania, 16, 19, 21. South Carolina, 30, 31. South Dakota, 14. Texas, 1, 7, 15, 23, 28. Utah, 7, 8, 10, 26, 28. Washington, 10, 31. West Virginia, 16. Wisconsin, 15.

The dates when hail was reported in the greatest number of States were: 15th, 10; 14th, 9; 17th, 9; 16th, 8.

#### SLEET.

The following are the dates on which sleet fell in the respective States:

Arizona, 9, 10. California, 9, 13, 14, 15, 16, 17, 18, 20, 21, 25, 26. Colorado, 5, 9, 10, 12, 14, 30. Connecticut, 4, 5, 16, 21, 22, 31. Delaware, 4. Idaho, 6, 7, 9, 12, 13, 15, 20, 25, 28. Illinois, 12, 23, 30. Indiana, 15, 16, 22, 23. Indian Territory, 23. Iowa, 10, 11, 17, 21, 22, 27. Kansas, 11, 22, 26, 27, 28. Kentucky, 1, 2, 29, 30. Maine, 17, 19, 22. Maryland, 2, 4, 21. Massachusetts, 4, 16, 22, 23, 31. Michigan, 9, 10, 11, 12, 13, 15, 18, 22, 27. Minnesota, 9, 14, 15, 16, 18, 22, 27, 28, 31. Missouri, 1, 4, 13, 22, 23, 27, 28. Montana, 3, 7. Nebraska, 10, 14, 18, 22, 26, 27. Nevada, 9, 13, 14, 15, 16, 21, 24. New Hampshire, 16, 17. New Jersey, 3, 4, 21, 24. New Mexico, 11. New York, 20, 21, 22, 23. North Carolina, 2, 4. North Dakota, 11, 12, 14, 15, 20. Ohio, 23, 24, 29. Oklahoma, 23. Oregon, 9, 12, 14, 16, 24, 25, 26, 28. Pennsylvania, 4, 15, 16, 21, 22, 30. South Dakota, 8, 26. Virginia, 2, 4, 17. Washington, 7, 9, 12, 13, 14, 15, 20, 23, 24, 25, 26, 27, 28. West Virginia, 31. Wisconsin, 10, 11, 15, 18, 21, 22, 25, 27, 28.

The dates when sleet was reported in the greatest number of States were: 4th, 9; 9th, 9; 14th, 8; 15th, 10; 16th, 9; 21st, 9; 22d, 12; 23d, 9.

#### HUMIDITY.

The humidity observations of the Weather Bureau are divided into two series; the first or tridaily series began in 1871 and ended with 1887; the second or twice-daily series is continuous from 1888 to the present time.

In the present state of knowledge respecting the diurnal variation in the moisture of the air, we are scarcely warranted in combining the two series in a general mean.

The monthly means of the second or present series are based upon observations of the whirled psychrometer at 8 a. m. and 8 p. m., seventy-fifth meridian time, which corresponds to 5 a. m. and 5 p. m., Pacific; 6 a. m. and 6 p. m., Mountain; and 7 a. m. and 7 p. m., Central standard time.

The normal for any district can be obtained by adding the departure to the average of the current month when the current humidity is below the normal (—), and subtracting it when it is above (+).

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England .....	60	+ 5	Missouri Valley .....	70	— 2
Middle Atlantic .....	76	+ 5	Northern Slope .....	69	+ 3
South Atlantic .....	81	+ 7	Middle Slope .....	58	— 3
Florida Peninsula .....	74	— 4	Southern Slope .....	53	— 3
East Gulf .....	82	+ 8	Southern Plateau .....	35	— 5
West Gulf .....	78	+ 8	Middle Plateau .....	60	+ 6
Ohio Valley and Tennessee .....	74	+ 4	Northern Plateau .....	70	— 0
Lower Lake .....	55	— 1	North Pacific Coast .....	75	— 5
Upper Lake .....	79	+ 1	Middle Pacific Coast .....	65	— 11
North Dakota .....	75	— 12	South Pacific Coast .....	62	— 12
Upper Mississippi Valley .....	73	+ 2			

In using the table by means of which the amount of moisture in the air is computed from the readings of the wet and dry bulb thermometers, the pressure argument has almost always been neglected, an omission that has little significance except for low temperatures and at high stations, such as Santa Fe, El Paso, Cheyenne, and a few others. The failure to apply a correction for the influence of the prevailing pressure on the psychrometer has the effect of making the monthly means of relative humidity at high-level stations too small by quantities ranging from 5 to 10 per cent. In the application of

the monthly averages of the above table, or those of individual stations in Table I, to special inquiries, whether in the departments of biology, climatology, or sanitary science, this fact should be kept in mind. It should also be remembered that the hours at which observations in the Rocky Mountain Plateau Region are made, viz, at 5 or 6 local mean time, morning and afternoon, give approximately the maximum and minimum values for the day; probably the means of such hours approach more nearly the true mean of the month than is the case on the Atlantic seaboard and in the seventy-fifth meridian time belt.

### WIND.

*High winds and local storms.*—The high winds of the month occurred in connection with the atmospheric disturbances of the 14th, 21st, and 27th. The winds on the plains and in upper Missouri and Mississippi valleys were unusually high on the afternoon of the 14th.

15th.—A minor tornado passed through the eastern edge of the village of Hunter, Ark., about 4 a. m. of the 15th. Five persons were injured; 6 buildings were destroyed, involving a loss of \$2,000. The width of the path of greatest destruction was 300 feet; length, 2 miles; direction of movement, toward the northeast.

18th.—An incipient tornado passed over Mound, Ill., at 7 p. m. of the 18th. No casualties; property loss about \$1,000. The storm cloud did not reach the earth.

26th.—A very severe thunderstorm with some of the characteristics of a tornado passed through the southeastern portion of Indian Territory during the evening of the 26th. Seven people were injured at Coalgate, Ind. T.; 4 houses were destroyed and perhaps 50 others more or less damaged. One building was destroyed at Phillips, Ind. T., not far distant from Coalgate. The rainfall was very heavy.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
		Miles				Miles	
Amarillo, Tex.	14	56	w.	El Paso, Tex.	21	63	sw.
Do.	21	63	sw.	Do.	22	54	sw.
Do.	27	56	n.	Do.	26	51	sw.
Block Island, R.I.	4	64	ne.	Do.	27	50	sw.
Do.	5	56	ne.	Fort Canby, Wash.	27	54	s.
Buffalo, N. Y.	13	60	sw.	Huron, S. Dak.	14	51	se.
Do.	19	53	sw.	Lincoln, Nebr.	21	52	nw.
Carson City, Nev.	12	53	sw.	Moorhead, Minn.	14	50	se.
Do.	25	54	sw.	Do.	15	52	se.
Cheyenne, Wyo.	14	50	nw.	Pierre, S. Dak.	15	53	w.
Do.	18	51	nw.	Pueblo, Colo.	18	50	sw.
Chicago, Ill.	18	53	se.	Savannah, Ga.	3	51	ne.
Do.	27	50	s.	Sioux City, Iowa	14	60	s.
Do.	28	62	w.	Do.	21	52	nw.
Cleveland, Ohio	13	61	w.	Do.	22	50	n.
Denver, Colo.	8	53	nw.	Tatoosh Island, Wash.	20	52	nw.
Do.	14	52	nw.	Yankton, S. Dak.	14	50	s.
Dodge City, Kans.	14	59	sw.				

### SUNSHINE AND CLOUDINESS.

The quantity of sunshine, and therefore of heat, received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends upon the absorption by the atmosphere, and varies largely with the distribution of cloudiness. The sunshine is now recorded automatically at 21 regular stations

of the Weather Bureau by its photographic, and at 47 by its thermal effects. The photographic record sheets show the apparent solar time, but the thermometric records show seventy-fifth meridian time; for convenience the results are all given in Table IX for each hour of local mean time. In order to complete the record of the duration of cloudiness these registers are supplemented by special personal observations of the state of the sky near the sun for an hour after sunrise and before sunset, and the cloudiness for these hours has been added as a correction to the instrumental records, whence there results a complete record of the duration of sunshine from sunrise to sunset.

The average cloudiness of the whole sky is determined by numerous personal observations at all stations during the daytime, and is given in the column "average cloudiness" in Table I; its complement, or percentage of clear sky, is given in the last column of Table IX for the stations at which instrumental self-registers are maintained.

The percentage of clear sky (sunshine) for all of the stations included in Table I, obtained as described in the preceding paragraph, is graphically shown on Chart VII. The regions of cloudy and overcast skies are shown by heavy shading; an absence of shading indicates, of course, the prevalence of clear, sunshiny weather.

The formation of fog and cloud is primarily due to differences of temperature in a relatively thin layer of air next to the earth's surface. The relative position of land and water surfaces often greatly increases the tendency to form areas of cloud and fog. This principle is perhaps better exemplified in the Lake Region than elsewhere, although it is of quite general application. The percentage of sunshine on the lee shores of the Lakes is always much less than on the windward shores. Next to the permanent influences that tend to form fog and cloud may be classed the frequency of the passage of cyclonic areas.

*The current month.*—Clear, sunshiny weather prevailed in Florida, the Southwest, the great valley of California, and the southern coast of the same State. There was also a greater percentage of sunshine than usual in New England, the Lake Region, the Missouri Valley, and the north Pacific Coast. Strangely enough the least sunshine in the United States was experienced in central Kentucky. Less sunshine than usual was also experienced in the Middle, South Atlantic, and Gulf States, the Ohio Valley and Tennessee, and on the Northern and Middle Slopes.

### Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.4	-0.2	Missouri Valley	5.3	-0.3
Middle Atlantic	6.4	+0.9	Northern Slope	5.8	+0.5
South Atlantic	5.4	+0.7	Middle Slope	5.1	+0.7
Florida Peninsula	3.5	-0.5	Southern Slope	5.0	+0.8
East Gulf	5.6	+0.9	Southern Plateau	2.9	-0.1
West Gulf	6.5	+1.3	Middle Plateau	5.2	+0.3
Ohio Valley and Tennessee	6.4	+0.5	Northern Plateau	5.6	-0.9
Lower Lake	5.9	-0.5	North Pacific Coast	5.8	-0.8
Upper Lake	5.7	-0.2	Middle Pacific Coast	3.8	-1.2
North Dakota	5.2	-0.3	South Pacific Coast	3.2	-1.3
Upper Mississippi Valley	5.6	+0.1			

### ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IX, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.



**Thunderstorms.**—The dates on which the number of reports of thunderstorms for the whole country were most numerous were: 18th, 184; 19th, 180; 15th, 150; 17th, 146; 16th, 144.

Reports were most numerous from Missouri, 215; Illinois, 211; Ohio, 171; Kansas, 96; Arkansas, 93.

**Auroras.**—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, from the 3d to the 11th, inclusive.

The greatest number of reports were received for the following dates: 13th, 30; 14th, 289; 15th, 252; 16th, 27.

Reports were most numerous from Illinois, 56; Wisconsin,

54; New York, 52; Ohio, 48; Massachusetts, 47; Minnesota, 42.

**In Canada.**—Auroras were reported as follows: Halifax, 14, 15; Grand Manan, 15; Yarmouth, 14, 15; Charlottetown, 15; Father Point, 15; Quebec, 15, 20; Montreal, 14, 15, 16; Rockliffe, 14, 15; Toronto, 14; White River, 15, 16, 18; Port Stanley, 14; Saugeen, 14; Parry Sound, 15; Minnedosa, 18, 19, 20, 22; Swift Current, 26; Prince Albert, 9, 21, 26, 29, 30; Battleford, 21, 25, 26, 27; Esquimalt, 14, 15, 16.

Thunderstorms were reported as follows: Montreal, 17; Toronto, 16, 19, 28; White River, 27; Port Stanley, 16, 17; Parry Sound, 15, 16.

## CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following extracts relating to the general weather conditions in the several States and Territories are taken from the monthly reports of the respective sections of the Climate and Crop Service. The name of the section director is given after each summary.

Rainfall is expressed in inches.

**Alabama.**—The mean temperature was 59.6°, or 4.8° above normal; the highest was 89°, at Eufaula on the 24th, and the lowest, 23°, at Hamilton on the 4th and at Jasper on the 5th. The average precipitation was 3.22, or 2.43 below normal; the greatest monthly amount, 5.41, occurred at Newburg, and the least, 0.34, at Citronelle.—*F. P. Chaffee.*

**Arizona.**—The mean temperature was 50.7°, or about 5.0° below normal; the highest was 92°, at Fort Mohave on the 8th, and the lowest, zero, at Williams on the 14th. The average precipitation was 0.72, or slightly below normal; the greatest monthly amount, 3.89, occurred at Payson, while none fell at several stations.—*W. T. Blythe.*

**Arkansas.**—The mean temperature was 54.5°, or 3.4° above normal; the highest was 88°, at four stations on several dates, and the lowest, 18°, at Oregon, on the 3d and at Silversprings on the 24th. The average precipitation was 5.96, or 0.43 above normal; the greatest monthly amount, 17.56, occurred at Winslow, and the least, 1.20, at Fulton.—*E. B. Richards.*

**California.**—The mean temperature was 48.8°, or 3.6° below normal; the highest was 95°, at Salton on the 2d and 6th, and at Palm Springs on the 9th; the lowest was 16° below zero, at Bodie on the 18th. The average precipitation was 0.66, or 2.64 below normal; the greatest monthly amount, 4.22, occurred at Morses House, while none fell at several stations.—*W. H. Hammon.*

**Colorado.**—The mean temperature was 31.8°, or 3.0° below normal; the highest was 80°, at Lamar and Minneapolis on the 25th, and the lowest, 25° below zero, at Steamboat Springs on the 23d. The average precipitation was 0.88, or 0.38 below normal; the greatest monthly amount, 9.25, occurred at Ruby, and the least, 0.02, at Fort Morgan.—*P. H. Brandenburg.*

**Florida.**—The mean temperature was 67.5°, or about 2.0° above normal; the highest was 94°, at Bartow on the 23d, and the lowest, 30, at De Funiak Springs on the 5th. The average precipitation was 1.54, or considerably below normal; the greatest monthly amount, 3.26, occurred at Jupiter, while none fell at Kissimmee.—*A. J. Mitchell.*

**Georgia.**—The mean temperature was 61.0°, or 4.5° above normal; the highest was 90°, at Bellville on the 19th, and the lowest, 20, at Hopkinsville on the 5th. The average precipitation was 2.82, or 2.22 below normal; the greatest monthly amount, 8.52, occurred at Clayton, and the least, 0.91, at Hawkinsville.—*J. B. Marbury.*

**Idaho.**—The mean temperature was 31.4°; the highest was 74°, at New Plymouth on the 2d, and the lowest, 26° below zero, at Warren on the 22d. The average precipitation was 1.06; the greatest monthly amount, 3.23, occurred at Murray, and the least, trace, at Blackfoot and Chesterfield.—*D. P. McCallum.*

**Illinois.**—The mean temperature was 43.4°, or 4.8° above normal; the highest was 79° at Golconda on the 22d, and at Equality on the 26th, and the lowest, zero, at Lanark on the 3d. The average precipitation was 7.29, or 3.82 above normal; the greatest monthly amount, 14.16, occurred at Cobden, and the least, 2.66, at Lanark.—*C. E. Linney.*

**Indiana.**—The mean temperature was 45.8°, or 7.1° above normal; the highest was 83°, at Vevay on the 19th, and the lowest, 11°, at Hammond on the 2d. The average precipitation was 8.11, or 4.39 above normal; the greatest monthly amount, 14.65, occurred at Princeton, and the least, 0.59, at Hammond.—*C. F. R. Wapnerhans.*

**Iowa.**—The mean temperature was 37.5°, or several degrees above normal; the highest was 72°, at College Springs on the 26th, and the lowest,

2°, at Eldora, Neola, and Rock Rapids on the 1st, 22d, and 23d. The average precipitation was 1.94, or slightly above normal; the greatest monthly amount, 6.21, occurred at Fort Madison, and the least, 0.33, at Marshalltown.—*G. M. Chappel.*

**Kansas.**—The mean temperature was 43.0°, or 2.0° above normal; the highest was 85°, at Englewood on the 8th, and the lowest, 7° below zero, at Coolidge on the 22d. The average precipitation was 1.52, or 0.05 below normal; the greatest monthly amount, 6.72, occurred at Oswego, and the least, trace, at Coolidge and Macksville.—*T. B. Jennings.*

**Kentucky.**—The mean temperature was 50.7°, or 4.6° above normal; the highest was 84°, at Alpha and Williamsburg on the 19th, and the lowest, 16°, at Loretto on the 4th. The average precipitation was 7.59, or 2.40 above normal; the greatest monthly amount, 10.33, occurred at Lyndon, and the least, 2.75, at Williamsburg.—*G. E. Hunt.*

**Louisiana.**—The mean temperature was 62.4°, or about 2.0° above normal; the highest was 88°, at five stations on several dates, and the lowest, 22°, at Robeline on the 4th. The average precipitation was 2.88, or 1.75 below normal; the greatest monthly amount, 5.99, occurred at White Sulphur Springs, and the least, 0.55, at Donaldsonville.—*R. E. Kerkum.*

**Maryland and Delaware.**—The mean temperature was 47.6°, or 7.4° above normal; the highest was 84°, at Boettcherville and Cumberland, Md., on the 19th, and the lowest, 7°, at Deerpark, Md., on the 1st. The average precipitation was 3.66, or 0.34 above normal; the greatest monthly amount, 8.34, occurred at Sunnyside, Md., and the least at Distributing Reservoir, D. C.—*F. J. Wals.*

**Michigan.**—The mean temperature was 35.4°, or 7.2° above normal; the highest was 72°, at Mottville and Vandalia on the 16th and at Berrien Springs on the 21st, and the lowest, 19° below zero, at Humboldt on the 3d. The average precipitation was 3.20, or 1.38 above normal; the greatest monthly amount, 6.68, occurred at Howell Junction, and the least, 0.42, at Ewen.—*C. F. Schneider.*

**Minnesota.**—The mean temperature was 30.1°, or about 5.0° above normal; the highest was 67°, at Beardsley on the 7th, and the lowest, 18° below zero, at Tower on the 2d. The average precipitation was 1.21, or slightly below normal; the greatest monthly amount, 2.97, occurred at Mapleplain, and the least, 0.20, at Milaca.—*T. S. Outram.*

**Mississippi.**—The mean temperature was 60.1°, or 3.7° above normal; the highest was 91°, at Columbus on the 21st, and the lowest, 20°, at Louisville on the 3d. The average precipitation was 3.93, or 2.22 below normal; the greatest monthly amount, 6.87, occurred at Jackson, and the least, 0.15, at Mosspoint.—*R. J. Hyatt.*

**Missouri.**—The mean temperature was 44.8°, or 2.7° above normal; the highest was 83°, at Malden on the 18th, and the lowest, 9°, at Potosi on the 4th. The average precipitation was 7.18, or 3.78 above normal; the greatest monthly amount, 15.48, occurred at Willowsprings, and the least, 1.63, at Bolckow. The precipitation was remarkably heavy over the eastern and southern portions of the State.—*A. E. Hackett.*

**Montana.**—The mean temperature was 23.6°, or below normal; the highest was 68°, at Billings on the 7th, at Choteau on the 6th, and at Fort Logan on the 2d; the lowest was 37° below zero, at Adel on the 22d. The average precipitation was 2.01, or 0.96 above normal; the greatest monthly amount, 4.60, occurred at Dearborn Canyon, and the least, 0.30, at St. Pauls.—*J. Warren Smith.*

**Nebraska.**—The mean temperature was 35.0°, or about 1.0° above normal; the highest was 81°, at Curtis on the 8th, and the lowest, 14° below zero, at Gering on the 22d. The average precipitation was 0.61, or about 0.56 below normal; the greatest monthly amount, 2.25, occurred at Burchard, and the least, trace, at several stations in the western section.—*G. A. Loveland.*

**Nevada.**—The mean temperature was 35.0°, or about 4.0° below normal; the highest was 79°, at St. Thomas on the 4th, and the lowest, 10° below zero, at Wells on the 15th. The average precipitation was 0.63,